



TENNESSEE BUREAU OF INVESTIGATION

Forensic Services Division

Microanalysis Standard Operating Procedures Manual

Chemical Spray Analysis

Chemical Spray Analysis

1. Scope

The purpose of this procedure is to analyze items that may have come in contact with chemical “pepper” sprays. The analysis is designed to identify any of the three major components of commercial sprays, including alpha-chloroacetophenone (CN), ortho-chlorobenzalmalononitrile (CS), and oleoresin capsicum or capsaicin (OC). Other capsaicinoids may be identified in natural capsaicin.

2. Terms and Definitions

Lachrymator - tear-producing substance: a substance that makes tears form in the eyes, e.g. tear gas.

Capsaicin - chemical from peppers: a colorless compound. Source: hot peppers. Use: medicine, flavoring. $C_{18}H_{27}NO_3$.

3. References

Nowicki, J. “Analysis of Chemical Protection Sprays by GC/MS”; *Journal of Forensic Sciences*, 1982, 27, 3, 704-709.

Fung, T.; Jeffrey, W.; Beveridge, A.D. “The Identification of Capsaicinoids in Tear Gas Sprays”; *Journal of Forensic Sciences*, 1982, 27, 4, 812-821.

Martz, “A Comparison of Ionization Techniques for Gas Chromatography/Mass Spectroscopy Analysis of Dye and Lachrymator Residues from Exploding Bank Security Devices”; *Journal of Forensic Sciences*, 1983, 28, 200.

Ferslew, “Spectral Differentiation and Gas Chromatographic/Mass Spectrometric Analysis of the Lachrimators 2-Chloroacetophenone and O-Chlorobenzylidene Malononitrile”, *Journal of Forensic Sciences*, 1986, 31, 658.

Mongan, A.L.; Buel, E. “Identification of Dog Repellent in the Clothes of an Assault Suspect Using Gas Chromatography/Mass Spectrometry”, *Journal of Forensic Sciences*, 1995, 40,3, 513-514.



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Gag, J.A.; Merck, N.F. "Concise Identifications of Commonly Encountered Tear Gases"; *Journal of Forensic Sciences*, 1977, 22, 358-364.

4. Examination Procedures

4.1. Evidence Types

Any item which is believed to have come in contact with a chemical spray.

4.2. Reagents and Chemicals

Ethanol ACS grade

4.3. Instruments and Equipment

Gas Chromatograph/Mass Spectrometer
Ultraviolet (UV) light
Petri dishes
Beakers
Scissors
Scalpel blades
Photographic equipment with accessories

4.4. Procedural and Chemical Precautions

Refer to the TBI Safety Manual for general safety requirements and hazard information regarding the use of reagents and solvents, and overall safety guidelines.

Alpha-chloroacetophenone (CN), ortho-chlorobenzalmalononitrile (CS) and oleoresin capsicum or capsaicin (OC) are lachrymators and shall be handled in a hood with appropriate protective clothing, gloves and eyewear.

Items, which may have come in contact with chemical sprays, shall be handled with caution by wearing appropriate clothing, gloves and eyewear. It is not necessary for these items to be handled in a hood.

Protective attire, including laboratory coat, mask, gloves and eye protection should be used when working with clothing and/or bloodstained items.



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Decontamination of a scientist's work area should be performed after each use, but shall be done after analyzing bloodstained items.

Hazardous chemicals shall be used in a chemical fume hood.

4.5. Limitations

If the spray does not contain an ultraviolet (UV) dye, then it is difficult to determine where the spray is on the item.

Chemical spray components may degrade or evaporate.

4.6. Procedure

Document submitted samples according to *Microanalysis Quality Assurance Policy*.

Evidence may be photographed for case file documentation.

Spread items out on catch paper in a darkened room. Using ultraviolet (UV) light, examine evidence for spray. Most chemical sprays contain an UV dye and will fluoresce under UV light. If no fluorescence is observed, then it may be stated that either no chemical spray is present or it is such a small amount that an analysis could not be performed. If fluorescence is observed, the areas shall be marked.

Cut out areas that were marked and extract the stains with ethanol.

Concentrate the ethanol to a small volume.

Prepare known standards of OC, CS, and CN in ethanol.

(Optional) Spray a clean cloth with chemical spray believed to be used in the case. Allow cloth to dry. Extract the cloth with ethanol. Concentrate ethanol to a small volume.

Inject known standards, cloth standards, and unknown(s) into the gas chromatograph/mass spectrometer. Inject blanks before and between samples.



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Compare retention times and mass spectra of peaks in unknown to peaks in known standards. (Optional) Search unknown mass spectra against mass spectral library.

5. Measurement Traceability

There are no measurements made in this examination.

6. Reference Materials

Known alpha-chloroacetophenone standard
Known ortho-chlorobenzalmalononitrile standard
Known oleoresin capsicum or capsaicin standard

7. Reports

The following are possible results concluded from the examination:

Results should include the identity of chemical components identified in the analysis.

If no components are identified, then results should state that no components of chemical sprays were identified.

Analysis may be reported as inconclusive if an insufficient unknown sample is recovered.